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Mechanics of Crust Rupture and Erosion

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Despite their recognized importance worldwide, very little work has addressed the physical characteristics of crusts in relation to the threshold for particle entrainment by wind, their response to impact, and the mechanisms by which they disintegrate. Over the last several years parallel and complimentary studies of the mechanics of crust rupture and erosion have been carried at the University of Aberdeen and Trent University. The work at Aberdeen has specialized in crusts formed from clay minerals, as well as the development of physical models designed to compliment the measurement of crust strength using a needle penetrometer. Research at Trent has focused upon biological crusts, which are thinner and weaker, but more elastic than clay-set crusts. These surfaces rupture initially under grain impact, though eventually undercutting of the thin crust leads to large-scale mass loss as wind drag on the surface pries off large flakes. Measurement of crust failure in flexure testing appears to be appropriate in the analysis of crust breakdown at this advanced stage of wind erosion.

A number of important research questions have emerged from this work which are now being addressed in collaborative experiments. These experiments focus upon characterising the susceptibility of crusted surfaces to the abrasion that occurs during saltation. Penetrometry seems to be a reliable method for evaluating the *relative* strength of varied crust types, but in fact we still don't know much about what the absolute values actually mean. Most test plots show an early maximum peak strength and then a series of minor peaks until the penetrometer reaches the unconsolidated sand below the crust. Does this mean that the breaking of the adjacent interparticle bonds by the initial penetration leads to cracks that extend to the surrounding material? As a consequence, the applied load would not need to be as high during the rest of the penetration. An important question to address is whether or not saltating particles have the same effect. Recent wind tunnel experiments at Trent seem to suggest that some form of fatigue is important, since the duration of impact seems to outweigh the importance of impact velocity as a control of mass loss. Ongoing experiments also address effects associated with the rate of loading, the diameter of the needle relative to grain size, and the angle and spacing of the crust penetrations.